

CLAIMS

1. Treatment process for a mix of materials originating from residues from grinding of consumable articles at the end of their lives into fragmented form, to pre-concentrate this mix into recoverable materials and at least partly eliminate materials contaminating the recoverable materials, the said mix to be treated comprising:

✓ a fraction of recoverable materials, consisting of non-expanded synthetic polymer materials with various natures and/or compositions and/or shape factors, in the form of fragments varying from a rigid state to a flexible state,

✓ fractions of contaminating materials formed from mineral materials and/or metallic materials and/or organic materials other than non-expanded polymer materials and/or synthetic polymer materials in an expanded state,

characterised in that it comprises:

a) a first mechanical separation step by screening and/or shape factor to at least partly extract the fraction of contaminating mineral materials, from the mix of fragmented materials,

b) an aeraulic separation step by gas flow, comprising one input for the mix of materials originating from step a), from which the mineral materials fraction has been at least partly removed, and three outputs for extraction of separated material fractions in which the first fraction (b1) consists of a fraction of ultra-lightweight and/or expanded synthetic polymer materials, the second fraction (b2) consists of a fraction of heavy materials present in the mix and the third fraction (b3) consists of a fraction of synthetic polymer materials to

be recovered, in fragmented form varying from a rigid state to a flexible state,

c) a step to grind the fraction (b3) of recoverable polymer materials originating from step b),
5 to the liberation mesh of contaminating materials included in, adhering to or assembled with fragments of the fraction of polymer materials to be recovered,

d) a second mechanical separation step by screening and/or aeraulic separation by gas flow,
10 separating the fraction of synthetic polymer materials to be recovered originating from the grinding step c) to at least partly eliminate the fraction of contaminating materials released during grinding and to extract the fraction of recoverable materials forming the required
15 mix, pre-concentrated into recoverable materials, and still containing contaminants.

2. Process according to claim 1, characterised in that a density separation step in an aqueous medium of the
20 fraction of recoverable materials originating from step d) is set up, this separation being made at a threshold density «ds» chosen to obtain two fractions of recoverable materials preselected based on the chosen density threshold «ds» and pre-concentrated in
25 recoverable materials still containing contaminating materials.

3. Process according to either claim 1 or 2, characterised in that the mix of materials to be treated
30 contains non-expanded thermoplastic and thermosetting synthetic polymer materials as recoverable materials to be pre-concentrated, that are present in objects at the end of their lives and originating from destructive grinding.

4. Process according to any one of claims 1 to 3, characterised in that the recoverable materials are in the form of fragments for which the largest dimension is not more than 250 mm, and preferably not more than 200 mm.

5. Process according to any one of claims 1 to 4, characterised in that the mix of materials to be treated is subjected to separation by screening and/or shape factor according to step (d), the largest dimension of the screening mesh being equal to not more than 25 mm and preferably between 1 and 15 mm.

6. Process according to claim 5, characterised in that separation by screening and/or shape factor is made in a calibrated separation mesh device chosen from the group consisting of vibrating screen devices or rotating devices with a cylindrical separation surface.

7. Process according to any one of claims 1 to 6, characterised in that the recoverable materials originating from step (a) from which some of the contaminating materials have been removed, are subjected to aeraulic separation by suction and/or blowing in a single aeraulic separation means comprising at least two specific aeraulic separation zones, the first specific aeraulic separation zone simultaneously supplying the said means of aeraulic separation into a flow of materials to be separated for which the input flow is subjected to an early aeraulic separation as it enters the said zone with immediate separation of the fraction (b1) of ultra-lightweight materials to be eliminated and the immediate output of the said fraction (b1) using the

aeraulic separation means, the other specific aeraulic separation zone provided with a screening zone and also subjected to a gas flow that treats the mix of heavy and contaminating materials fraction (b2) and the recoverable lightweight materials fraction (b3) originating from the first specific zone, the gas flow separating the lightweight recoverable materials fraction (b3) and entraining it to an exit from the aeraulic separation means, while the contaminating heavy materials fraction (b2) is separated from the fraction (b3) by gravity and is eliminated from the aeraulic separation means through an appropriate exit.

8. Process according to claim 7, characterised in that the aeraulic separator with two specific separation zones may be chosen from the group composed of modular separators-cleaners-calibrators comprising screens and double suction.

9. Process according to any one of claims 1 to 6, characterised in that recoverable materials originating from step (a), from which the major part of contaminating materials has been eliminated, are subjected to aeraulic separation by suction and/or blowing into two aeraulic separation means installed in series.

10. Process according to claim 9, characterised in that the first aeraulic separation means receives the input flow of materials to be separated into fractions of contaminating and recoverable materials originating from step a), treats this flow in two fractions, such that the fraction (b1) of ultra-lightweight materials is extracted through the top part of the said first aeraulic separation means, while a mix of the fraction (b2) of

contaminating heavy material and the fraction (b3) of lightweight materials to be recovered is extracted through the bottom part of the said aeraulic separation means, and is then added in the second aeraulic separation means, the fraction (b2) of contaminating heavy materials being eliminated through the bottom part of the second aeraulic separation means while the fraction (b3) of materials to be recovered is extracted from the said second aeraulic separation means.

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11. Process according to claim 9, characterised in that the first aeraulic separation means receives the input flow of materials to be separated into fractions of contaminating and recoverable materials originating from step a), treats the flow in two fractions such that the fraction (b2) of contaminating heavy materials is extracted through the bottom part of the said aeraulic separation means while a mix of the fraction (b1) of contaminating ultra-lightweight materials and the fraction (b3) of recoverable lightweight materials is extracted through the top part of the first aeraulic separation means, and then this mix of fractions (b1) and (b3) is added into the second aeraulic separation means, the fraction (b1) of contaminating ultra-lightweight materials being eliminated through the top part of the said second aeraulic separation means, while the fraction (b3) of recoverable lightweight materials is extracted through the bottom part of the said aeraulic separation means.

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12. Process according to any one of claims 1 to 11, characterised in that the fraction (b1) of contaminating ultra-lightweight materials extracted from the aeraulic separation zone is subjected to an additional step of

separation by screening depending on their largest dimension and/or their shape factor to separate a fraction formed from materials with dimension smaller than the mesh size of the screen such as polymer powders, thread and/or film waste, small volumes of foam and a fraction composed of all foam flakes that would not pass through the screen meshes, and to recover them by an appropriate operation.

10 13. Process according to any one of claims 1 to 12, characterised in that the fraction b3) of polymer materials to be recovered originating from the aeraulic separation step b), that still contains contaminating materials included in, adhering to or assembled with the
15 polymer materials to be recovered, is subjected to a fine grinding action to reach at least the liberation mesh of contaminating materials contained in the polymer materials to be recovered, to release the said polymer materials to be reused from all contaminating materials.

20 14. Process according to claim 13, characterised in that the liberation mesh of contaminating materials leads to at least fine fragmentation by grinding resulting in polymer particles to be recovered with a largest
25 dimension equal to not more than 50 mm, preferably not more than 25 mm, and even better between 1 mm and 15 mm.

15. Process according to any one of claims 1 to 14, characterised in that, in the case in which the flow of
30 finely ground materials originating from step c) and input into step d) contains not more than 20% by weight of water, the various ultra-lightweight, lightweight and heavy material fractions in this flow are separated aeraulically in a separation zone comprising at least one

aeraulic separation means operating by blowing in and/or suction of a gas flow, this zone comprising an input of the mix of materials originating from step c) to be separated and three outputs through which a fraction (d1) of ultra-lightweight polymer and/or expanded materials to be eliminated, a fraction (d2) consisting of contaminating heavy materials to be eliminated and a fraction (d3) formed of polymer materials to be recovered, this final fraction (d3) forming the flow of recoverable pre-concentrated materials.

16. Process according to claim 15, characterised in that, when the aeraulic separation zone in step d) comprises a single aeraulic separation means, this separation means itself comprises at least two specific separation zones for the materials to be separated, one of the specific aeraulic separation zones being the zone that simultaneously supplies materials to be separated for which the input flow is subjected to an early aeraulic separation as it enters the said zone and immediate exit of the fraction (d1) of ultra-lightweight materials to be eliminated in a gas flow, the other specific aeraulic separation zone, provided with a screening surface and subjected to a gas flow, treats the mix of the fraction (d2) of heavy and contaminating materials and the fraction (d3) of recoverable materials originating from the first specific zone, the gas flow separating the lightweight recoverable materials fraction (d3) and entraining it to an exit from an aeraulic separation means, while the contaminating heavy materials fraction (d2) is separated from the fraction (d3) by gravity and is eliminated from the aeraulic separator through an appropriate exit.

17. Process according to claim 15, characterised in that, when the separation zone comprises two aeraulic separation means, the said separation means are installed in series such that at least one output from the
5 contaminating material fractions (d1) and (d2) is located on the first aeraulic separation means.

18. Process according to claim 17, characterised in that the first aeraulic separation means receives the input
10 flow of materials to be separated into fractions of contaminating and recoverable materials originating from step c), treats this flow in two fractions such that the ultra-lightweight materials fraction (d1) is extracted through the top part of the first aeraulic separation
15 means, while a mix of the fraction (d2) of contaminating heavy materials and the fraction (d3) of materials to be recovered is extracted through the bottom part of the said aeraulic separation means and this mix of fractions (d2) and (d3) is added into the second aeraulic
20 separation means, the fraction of heavy materials (d2) being eliminated through the bottom part of the said aeraulic separation means, while the fraction (d3) of materials to be recovered is extracted from step d) to form the fraction pre-concentrated in polymer materials
25 to be recovered.

19. Process according to claim 17, characterised in that the first separation means into which the input flow of materials to be separated into fractions of contaminating
30 and recoverable materials originating from step c) treats the flow in two fractions such that the fraction of contaminating heavy materials (d2) is extracted through the bottom part of the said first aeraulic separation means, while a mix of the fractions of contaminating

ultra-lightweight materials (d1) and recoverable materials (d3) is extracted through the top part of the said first aeraulic separation means and this mix of ultra-lightweight contaminating materials (d1) and recoverable materials (d3) is then added into the second aeraulic separation means, the fraction of contaminating ultra-lightweight materials (d1) being eliminated through the top part of the second aeraulic separation means, while the recoverable materials fraction is extracted through the bottom part of the said separation means to form the fraction pre-concentrated in polymer materials to be recovered.

20. Process according to any one of claims 1 to 14, characterised in that in the case in which the finely ground materials flow originating from step c) and input into step d) contains not less than 20% by weight of water, a mechanical separation by screening and/or shape factor can be done using a device with a screening means adapted to the shape of fragments of recoverable materials.

21. Process according to claim 20, characterised in that the screening means is a screen with a calibrated separation mesh, the largest calibrated mesh dimension being equal to not more than 25 mm, and preferably not more than 10 mm.

22. Process according to any one of claims 1 to 21, characterised in that the extracted fraction of recoverable polymer materials preferably contains at least 85% by weight of the said recoverable polymer materials.

23. Use of fractions pre-concentrated in recoverable polymer materials resulting from any one of claims 1 to 22 as input to selective separation processes for the separate extraction of each recoverable polymer.